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# Self-confidence of anglers in identification of freshwater sport fish

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**Abstract** Although several studies have focused on how well anglers identify species using replicas and pictures, there has been no study assessing the confidence that can be placed in angler's ability to identify recreationally important fish. Understanding factors associated with low self-confidence will be useful in tailoring education programmes to improve self-confidence in identifying common species. The purposes of this assessment were to quantify the confidence of recreational anglers to identify 13 commonly encountered warm water fish species and to relate self-confidence to species availability and angler experience. Significant variation was observed in anglers self-confidence among species and levels of self-declared skill, with greater confidence associated with greater skill and with greater exposure. This study of angler self-confidence strongly highlights the need for educational programmes that target lower skilled anglers and the importance of teaching all anglers about less common species, regardless of skill level.

**KEY WORDS :** angler skill, education, fish identification.

## Introduction

The ability of anglers to identify their catch correctly is an important assumption made by fishery managers and is required for regulations to function as intended. Yet, several studies have indicated that many anglers, particularly those with low skill, do not correctly identify individual fish species. Depending on the fish species identified and angler experience, 38–96% of North American anglers correctly identified images, mount replicas or harvested fish belonging to the family Salmonidae (Schmetterling & Long 1999; Lamansky *et al.* 2001; Stelfox *et al.* 2001; Bowlby & Savoie 2011). Among warm water fisheries, 4–85% of Ohio anglers were able to correctly identify colour drawings of warm-water sport fish, having greater ability to identify the most common fish species (e.g. largemouth bass

*Micropterus salmoides* (Lacepède)) (Page *et al.* 2012). However, more than 80% of the Ohio anglers were able to identify fish images correctly using broader taxonomic levels (e.g. sunfish, crappie *Pomoxis* spp, and black bass *Micropterus* spp.) (Page *et al.* 2012).

Anglers' abilities to identify captured fish correctly influence the efficacy of tools such as creel surveys and harvest regulations that biologists often rely on to manage recreational fisheries. Based on a simulation of the effects of identification error, error in estimates of catch rates derived from angler surveys could vary up to 386% over a 30-day period (Page *et al.* 2012). Further, inability of anglers to distinguish among species or taxa could lead to non-compliance of taxon-specific regulations (Roach *et al.* 1999; Schill *et al.* 2001). Many management agencies appear to be aware of a general inability to distinguish among individual species by rec-

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reational anglers, as these agencies often regulate and collect information at broad taxonomic levels (Page *et al.* 2012).

Although there have been several studies examining the ability of anglers to identify fish correctly (Stelfox *et al.* 2001; Page *et al.* 2012), there has been no study in the peer-reviewed literature investigating the self-confidence of anglers in their abilities to identify warm-water fish. Previous studies assessing identification accuracy do not indicate whether species were incorrectly identified because anglers were uninformed or misinformed and whether species correctly identified were done so through a guess. Thus, there is a need to assess angler self-confidence in sport fish identification to pinpoint areas for educational development to improve angler confidence. Furthermore, factors (e.g. frequency of angling and frequency of occurrence of the sport fish) related to angler's self-confidence in fish identification have not been investigated. As such, the purposes of this study were to quantify angler self-confidence in identifying 13 warm-water fish species and determine if that self-confidence was correlated to species availability and angler experience. Angler self-confidence and experience were quantified through responses to a return-mail survey that was hand-delivered to anglers contacted in the Salt Creek watershed of Nebraska (Martin & Pope 2011).

## Methods

### Data collection

Anglers were interviewed year-round during 2010–2012 at reservoirs in the Salt Creek watershed in south-eastern Nebraska to gather information on fishing effort, catch and harvest. Survey days and times were selected based on a stratified multistage probability sampling regime (Malvestuto 1996). Each reservoir received the same sampling effort, 12 samples each month, which was evenly split between 2 day type (weekday and weekend plus federal holidays) and three time (00:00–07:59, 08:00–15:59 and 16:00–23:59) strata.

Technicians intercepted anglers at access points. Anglers who participated in an in-person survey were asked to participate in an unlinked, return-mail survey. This survey was to be completed at home and returned in a postage-paid envelope (e.g. Ditton & Hunt 2001). The return-mail survey included detailed questions on angler demographics, angler behaviour, motivations, success, enjoyment and preferences. Specific questions were included to understand angler self-confidence in their ability to identify bluegill *Lepomis macrochirus* Rafin-

esque, green sunfish *L. cyanellus* Rafinesque, redear sunfish *L. microlophus* (Günther), white bass *Morone chrysops* (Rafinesque), white perch *M. americana* (Gmelin), hybrid striped bass *M. chrysops* × *M. saxatilis*, blue catfish *Ictalurus furcatus* (Valenciennes), channel catfish *I. punctatus* (Rafinesque), flathead catfish *Pylodictis olivaris* (Rafinesque), black crappie *Pomoxis nigromaculatus* (Lesueur), white crappie *P. annularis* Rafinesque, walleye *Sander vitreus* (Mitchill) and sauger *S. canadensis* (Griffith & Smith). These questions asked respondents to rate their self-confidence on a five-point scale (1 = not confident, 2 = a little confident, 3 = somewhat confident, 4 = very confident and 5 = extremely confident; Clason & Dormody 1994) to identify correctly the 13 species. Specific questions were also included to quantify fishing experience. These questions asked respondents to rate their skill level on a five-point scale (only three of the five points were labelled; 1 = amateur, 3 = average and 5 = highly skilled) and to quantify separately the number of days spent fishing annually within and outside the Salt Creek regional fishery. The survey also contained a question asking if the angler carried a fish identification guidebook when they were fishing and the number of years with a fishing licence.

### Data analyses

It was assumed a species occurred in a Salt Creek reservoir if >25 fish were caught by anglers across years (as enumerated from angler interviews and not from extrapolated estimates). A cut-off of 25 was used to diminish the possibility that a fish reported caught in a reservoir was misidentified by a few anglers and to remove species so rarely caught by anglers that the species was essentially unavailable to the general angling public. This method using fish caught via hook and line was more representative of the species available to anglers than a method using fish caught via trap nets and boat electrofishing. The percent occurrences for each species were calculated across reservoirs in the Salt Creek watershed ( $N = 17$ ). The school of thought in the analysis of Likert-type data is controversial and subject to considerable debate (Jamieson 2004; Carifio & Perla 2008). Thus, a nonparametric approach using methodology that seemed most appropriate for the data being analysed was adopted. Kendall rank correlation was used to assess the relationship between species occurrence (a proxy for exposure of the species to anglers) and angler self-confidence among lower skilled anglers (skill levels 1 and 2) and among higher skilled anglers (skill levels 4 and 5) across all species except crappie. The association between angler skill level and days spent fishing within

and outside of the Salt Creek regional fishery was assessed using Kendall rank correlation. Although mail survey questions asked anglers about identifying black crappie and white crappie separately, percent occurrence was calculated in aggregate (i.e. crappie) because on-site interviews collected information on catch at the genus level for these two species. Angler self-confidence among angler skill levels was compared using a non-parametric Jonckheere–Terpstra distribution-free test for ordered alternatives for all species independently, including black crappie and white crappie. The Jonckheere–Terpstra test was accomplished using the ‘clinfun’ package (Seshan 2014) in R (R Development Core Team 2012). Chi-square analysis was used to assess whether carrying a guidebook during angling is independent of the angler’s self-declared skill level. All analyses assumed an alpha of 0.05.

## Results

In total, 4271 individuals agreed to complete the mail survey; 881 usable returned surveys were received (a 21% return rate). Percent occurrence for individual species caught by anglers across the reservoirs ranged from 0% (i.e. redear sunfish and sauger) to 100% (i.e. bluegill) (Table 1). Thirty anglers considered themselves skill level 1 (amateur); 49 – skill level 2; 335 – skill level 3 (average); 328 – skill level 4 and 139 – skill level 5 (highly skilled). The days fished within and outside of the Salt Creek watershed and years a fishing licence was held by anglers increased with skill level (Table 2).

Skill level was positively correlated with the number of days fished within ( $\tau = 0.19$ ,  $P < 0.001$ ) and outside ( $\tau = 0.30$ ,  $P < 0.001$ ) the Salt Creek watershed. There

were significant increases across skill levels in the number of years with a fishing licence ( $\tau = 0.17$ ,  $P < 0.001$ ). The chi-square analysis suggests that there was an association between carrying a guidebook and self-declared skill level ( $\chi^2 = 24.0$ , d.f. = 4;  $P < 0.001$ ). Forty-five percent of anglers that considered themselves skill level 1 carried a guide book, 55% for skill level 2, 58% for skill level 3, 45% for skill level 4 and 36% for skill level 5.

Self-confidence increased with skill level for identifying bluegill (Jonckheere–Terpstra test,  $JT = 155\ 860$ ;  $P < 0.001$ ), green sunfish ( $JT = 169\ 421$ ;  $P < 0.001$ ), redear sunfish ( $JT = 165\ 562$ ;  $P = 0.002$ ), walleye ( $JT = 173\ 817$ ;  $P = 0.002$ ), sauger ( $JT = 182\ 419$ ;  $P < 0.001$ ), white perch ( $JT = 168\ 467$ ;  $P < 0.001$ ), white bass ( $JT = 172\ 386$ ;  $P < 0.001$ ), hybrid striped bass ( $JT = 180\ 474$ ;  $P < 0.001$ ), channel catfish ( $JT = 160\ 400$ ;  $P < 0.001$ ), flathead catfish ( $JT = 165\ 131$ ;  $P < 0.001$ ) and blue catfish ( $JT = 162\ 572$ ;  $P < 0.001$ ). In general, self-confidence in identifying fish increased with angler skill (Fig. 1). Among lower skilled anglers (levels 1 and 2), self-confidence in identifying fish was positively correlated with frequency of species occurrence ( $\tau = 0.54$ ,  $P = 0.05$ ). Among higher skilled anglers (levels 4 and 5), self-confidence in identifying fish was not significantly correlated with frequency of species occurrence ( $\tau = 0.29$ ,  $P = 0.21$ ).

## Discussion

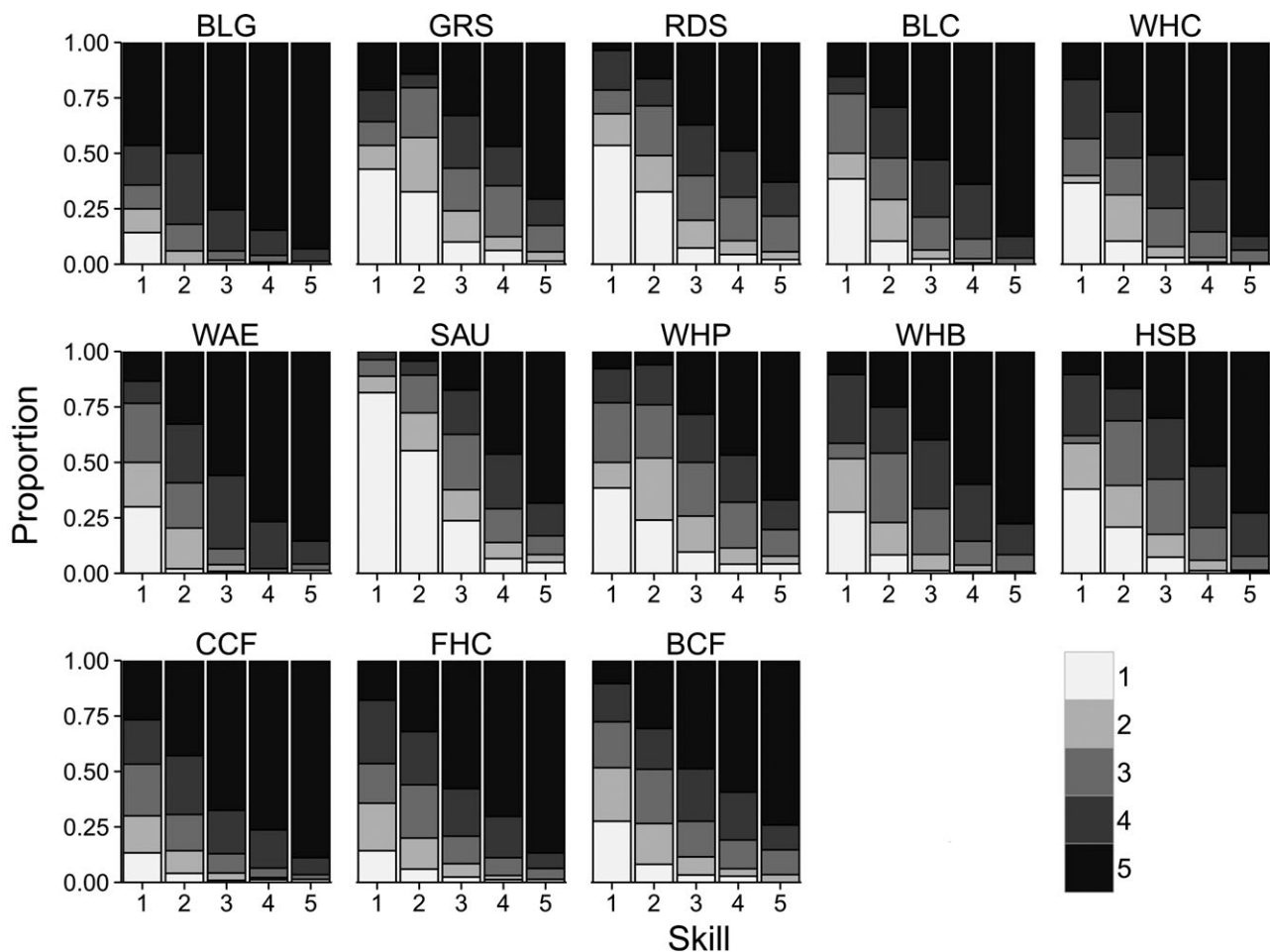
In general, anglers with lower skills (levels 1 and 2) had substantially lower self-confidence in identifying species than anglers with greater skill (levels 4 and 5). Given that skill levels were positively correlated to number of days fishing both within and outside of the Salt Creek watershed and the number of years with a fishing licence, it is likely that anglers who fish more are exposed to a greater number of species more frequently, thus increasing self-confidence in identifying fish species. For example, angler self-confidence in identifying

**Table 1.** Species, three-letter code (used in Fig. 1) and percent occurrence for sport fishes in the Salt Creek regional fishery, Nebraska. Occurrence is the percent of 17 Salt Creek reservoirs that contain the respective species

Species	Code	Occurrence (%)
Bluegill	BLG	100
Green sunfish	GRS	71
Redear sunfish	RDS	0
Black crappie and white crappie	BLC and WHC	94
Walleye	WAE	41
Sauger	SAU	0
White perch	WHP	29
White bass	WHB	18
Hybrid striped bass	HSB	24
Channel catfish	CCF	76
Flathead catfish	FHC	12
Blue catfish	BCF	17

**Table 2.** Mean  $\pm$  SE days fished within and outside of the Salt Creek watershed and the mean  $\pm$  SE years a fishing licence was held by anglers of different self-identified skill levels

Skill level	Days fished within watershed	Days fished outside watershed	Years fishing licence held
1	14.4 $\pm$ 2.7	5.7 $\pm$ 2.2	8.5 $\pm$ 2.3
2	13.5 $\pm$ 1.9	7.0 $\pm$ 1.7	18 $\pm$ 2.1
3	31.2 $\pm$ 2.1	9.9 $\pm$ 1.3	25.3 $\pm$ 0.9
4	37.4 $\pm$ 2.2	20.8 $\pm$ 1.8	30.3 $\pm$ 0.9
5	52.3 $\pm$ 4.5	35.6 $\pm$ 3.8	28.9 $\pm$ 1.1



**Figure 1.** Proportion of angler self-confidences (5-point scale; 1 = not confident, 2 = a little confident, 3 = somewhat confident, 4 = very confident and 5 = extremely confident) in identifying 13 species (codes defined in Table 1) for self-declared skill (5-point scale with three of the five points were labelled; 1 = amateur, 3 = average and 5 = very skilled).

sauger and redear sunfish, which were not commonly caught in any Salt Creek reservoir, was low, even among more experienced anglers. However, anglers' self-confidence in identifying bluegill, which was found in all of the Salt Creek reservoirs, was high, even among lower skilled anglers. Further, anglers fishing more frequently may have greater desire to learn more information about fishing (Beardmore *et al.* 2013), and increased knowledge of a topic should produce greater self-confidence. Several studies have indicated a positive relationship between experience and the ability of anglers to identify fishes correctly (Schmetterling & Long 1999; Lamansky *et al.* 2001; Bowlby & Savoie 2011; Page *et al.* 2012).

Anglers indicated a general lack of self-confidence among closely related species. For example, anglers in this study had similar self-confidence in ability to identify blue catfish, channel catfish and flathead catfish. It is possible that some of this self-confidence may be mis-

placed as Ohio anglers correctly identified channel catfish 69% of the time but most often confused them with blue catfish (8%), and correctly identified flathead catfish 29% of the time but most often confused them with channel catfish (43%) (Page *et al.* 2012). Thus, anglers may be relatively confident in their ability to identify a species although they may not know how to distinguish a particular species. This highlights a potential problem with angler compliance to regulations, particularly because species such as channel catfish and flathead catfish are often managed with different harvest regulations. Another potential problem with angler self-confidence in identifying closely related species can be observed among the moronids in this study. Anglers appear to be relatively confident identifying white bass and hybrid striped bass but appear to be relatively unconfident identifying white perch, even among higher skilled anglers. White perch is an invasive species, and given its ten-



dency to form high-density, stunted populations is a management concern in Nebraska (Chizinski *et al.* 2010). An inability or lack of self-confidence in identifying this invasive species, or distinguishing it from game species, could lead to the inadvertent spread (e.g. bait bucket introductions) of white perch by anglers (Hickley & Chare 2004; Chizinski *et al.* 2006).

This study of angler self-confidence, in conjunction with previous studies on the identification accuracy of anglers (Schmetterling & Long 1999; Lamansky *et al.* 2001; Bowlby & Savoie 2011; Page *et al.* 2012), strongly highlights the need for educational programmes to target lower skilled anglers. These lower skilled anglers lack the self-confidence to identify most of the species assessed as evidenced by the increased proportion of anglers carrying fish identification guides. Studies have indicated that education programmes increase ability to identify target species (e.g. Randler 2002; Koupal & Krasny 2003; Randler & Bogner 2006). For example, education tools (i.e. lists of identifying characteristics) improved the accuracy of Alberta angler identification for various trout species by 23%, with the greatest improvement (46%) observed among anglers that fished <1 year (Stelfox *et al.* 2001). Providing opportunities for inexperienced and unskilled anglers to learn fish identification will aid in the management of desired species by increasing the accuracy of angler surveys, aiding in angler compliance to regulations and limiting the unintentional spread of invasive species. Further, this study indicates the importance of teaching all anglers about less common species, regardless of skill level.

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